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Research Trends on the Use of Artificial Intelligence in Educational Environments in Southeast Asia on Scopus Database: A Bibliometric Analysis (2014-2024)

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Abstrak

Penelitian ini bertujuan untuk melihat tren penelitian di Database Scopus mengenai penggunaan AI dalam lingkungan pendidikan di Asia Tenggara. Dengan menggunakan kata kunci yang telah ditentukan dan diseleksi dengan metode PRISMA, peneliti mendapatkan 118 dokumen yang dianalisis dengan Program R dan VOSviewer. Dari hasil analisis, dapat disimpulkan bahwa penelitian tentang AI dalam Pendidikan di Asia Tenggara pada database Scopus dimulai dari tahun 2014 hingga 2024, dengan puncak kontribusi terjadi pada tahun terakhir. Singapura merupakan negara yang paling produktif, diikuti oleh Nanyang Technological University (NTU) sebagai afiliasi terdepan dalam publikasi di bidang ini. Sumber paling produktif berasal dari jurnal Sustainability (Swiss), sementara Sayed Fayaz Ahmad dari Pakistan tercatat sebagai penulis dengan kontribusi terbanyak dan indeks h tertinggi. Paranjape dkk. (2019) adalah studi dengan kutipan tertinggi. Terdapat tujuh cluster yang terbentuk, dengan kata kunci seperti "Computer Aided Instruction", "Chatbot", "ChatGPT", "Assessment", dan "Generative Artificial Intelligence" yang menjadi rekomendasi untuk penelitian lebih lanjut dalam bidang AI di bidang pendidikan di Asia Tenggara.

Kata kunci: *Bibliometrik, Kecerdasan Buatan, Pendidikan, Asia Tenggara*

Abstract

This study aims to look at research trends in the Scopus Database regarding the use of AI in educational settings in Southeast Asia. By using keywords that have been determined and selected by the PRISMA method, researchers get 118 documents that are analyzed with the R Program and VOSviewer. From the analysis, it can be concluded that research on AI in Education in Southeast Asia in the Scopus database started from 2014 to 2024, with the peak contribution occurring in the last year. Singapore is the most productive country, followed by Nanyang Technological University (NTU) as the leading affiliate in publications in this field. The most prolific source came from the journal Sustainability (Switzerland), while Sayed Fayaz Ahmad from Pakistan was noted as the author with the most contributions and highest h-index. Paranjape et al. (2019) is the study with the highest citations. There are seven clusters formed, with keywords such as "Computer Aided Instruction", "Chatbot", "ChatGPT", "Assessment", and "Generative Artificial Intelligence" being recommendations for further research in the field of AI in education in Southeast Asia.

Keywords: *Bibliometric, Artificial Intelligence, Education, Southeast Asia*

INTRODUCTION

Education flourished even in the midst of war, where its existence became an urgent need (Hamdi et al., 2024; Wahyuni et al., 2024). At that time, education was considered as one of the important factors that could provide hope and direction for the downtrodden society (Izzulhaq et al., 2024; Ramadhani & Retnawati, 2024). Various parties began to realize the importance of education to rebuild a better life order (Zafrullah, Ayuni, et al., 2024; Zafrullah, Hardi, et al., 2024). In addition, education also serves as a positive suggestion that encourages individuals to move forward even in difficult conditions (Zafrullah, Suyanto, et al., 2023; Zafrullah, Zetriuslita, et al., 2024). Thus, education is not just a transfer of knowledge, but also a means of mental liberation from fear and despair. Especially in modern times, education plays a crucial role in shaping a resilient generation that is ready to face global challenges.

Education in modern times plays a crucial role in shaping individuals who are ready to face the complexities of a globalized world (Zafrullah, Fitriani, et al., 2023; Zafrullah, Sultan, et al., 2024). Various factors, such as technology and access to information, have influenced the way education is delivered and received by society (Zafrullah, Meisya, et al., 2024; Zafrullah & Ramadhani, 2024). Learning methods are now more flexible, focusing on collaboration, innovation and creativity (Zafrullah, Hakim, et al., 2023; Zafrullah, Ibrahim, et al., 2024; Zafrullah & Zetriuslita, 2021). This makes the classroom no longer just a physical space, but also a virtual space that allows interaction without geographical boundaries (Andrian et al., 2020). Thus, the classroom in modern education is not only a place to learn,

but also a platform to broaden horizons and develop the potential of each learner. Thus, the classroom in the modern era becomes a bridge for individuals to access wider opportunities in life.

The classroom is a dynamic environment where interactions between teachers and students occur directly (Ma et al., 2024). The classroom becomes a place to build the knowledge, skills and character needed in everyday life. Classroom learning not only involves traditional methods, but also utilizes various approaches that are interactive and collaborative (Pathania et al., 2023). Thus, students can be actively involved in the learning process and exchange ideas, enriching their experience. In addition, technological developments provide opportunities to integrate many learning media that can enhance students' understanding and engagement (Kilag et al., 2023). Therefore, the presence of various learning media in the classroom is very important to create an interesting and effective learning atmosphere.

Learning media serves as a tool that helps convey information effectively and interestingly for students (Sudarsana et al., 2020). Varied learning media can improve understanding and retention of knowledge. In the context of modern education, learning media is not only limited to textbooks, but also includes videos, apps, and interactive online platforms (Sulastiani et al., 2023). Thus, students can learn in a way that suits their respective learning styles (Verde & Valero, 2021). The use of innovative learning media can create a more enjoyable learning atmosphere and stimulate curiosity (Sudarsana et al., 2020). With the advancement of technology, especially in the development of artificial intelligence, learning media can be tailored to the individual needs of students, thus increasing the effectiveness of the learning process.

Artificial intelligence is a technology that is capable of mimicking human thought processes to help with various tasks (Sadiku et al., 2022). Artificial intelligence provides innovative solutions in learning, such as personalizing materials according to the needs and abilities of each student (Tapalova & Zhiyenbayeva, 2022). Education becomes more adaptive and flexible as AI is able to analyze students' learning progress in real-time (Gligorea et al., 2023). This allows teachers to provide more specific and focused guidance. In addition, AI also helps automate administrative tasks, allowing teachers to focus more on student interaction and development (Ahmad et al., 2022). Thus, artificial intelligence plays an important role in improving the quality of education and accelerating the achievement of learning goals.

The development of computer and communication technology has driven the development of artificial intelligence (AI) which is now an important part of the lives of 21st

century citizens and is used as a strategic tool to improve and advance various sectors of life, thus bringing a significant impact in modern society (Chen et al., 2020; Górriz et al., 2020). The term artificial intelligence (AI) was coined by John McCarthy in 1956 as a branch of computer science to create computers that behave like humans and now AI is defined as a data processing system that is capable of learning adapting synthesizing self-correcting and processing data for complex tasks and has the advantages of natural intelligence (Crompton & Burke, 2023; Pannu, 2015; Popenici & Kerr, 2017). The continuous advancement of technology and algorithms, artificial intelligence is now growing and has applications in various sectors, including automotive, finance, health, and also education in learning (Karyadi, 2023).

For twenty-five years, AI has continued to grow rapidly in education as technology continues to advance, supporting the advancement of AI in the teaching and education process in schools (Huang et al., 2021; Roll & Wylie, 2016). The application provided by AI is the digitization of resources, the use of game elements, and customized learning opens up many opportunities for the development of artificial intelligence applications in education to assist and support the teaching process by complementing the role of the teacher with ai as a technology-based assistant (Susanto, 2023; Zhai et al., 2021). The use of digital technologies and AI technologies in the educational process is conditionally divided into three areas: learning, practical research and training in the application of AI (Iriyani et al., 2023).

With the advancement of AI, more and more research on its application in educational settings is being conducted by researchers. This prompted a bibliometric analysis to understand the trends and development of these studies. The analysis of previous research shows that there are many studies related to AI in education in the Scopus database (Fitriani, 2023). However, the use of inappropriate keywords makes the document selection less accurate. In addition, the time coverage of the research is only until 2023 and does not focus on the Southeast Asia region. Therefore, researchers are interested in conducting a more in-depth bibliometric analysis of AI in education in Southeast Asia, using the Scopus database.

METHOD RESEARCH

This research aims to conduct a bibliometric analysis of the application of artificial intelligence (AI) in education. Bibliometric analysis is a method used to evaluate and map scientific literature based on a number of indicators, such as the number of publications, citations, and keyword trends that appear in related research (Ramadhani et al., 2024;

Ulwiyah, 2023; Zafrullah, Ramadhani, et al., 2024; Zafrullah, Sultan, et al., 2024). By using this approach, researchers can identify patterns, developments, and directions of ongoing research in the field of AI in education. It is hoped that this research will provide a clearer picture of research contributions in the Southeast Asian region and help identify future research opportunities. Before bibliometric analysis, documents were first selected using the PRISMA method.

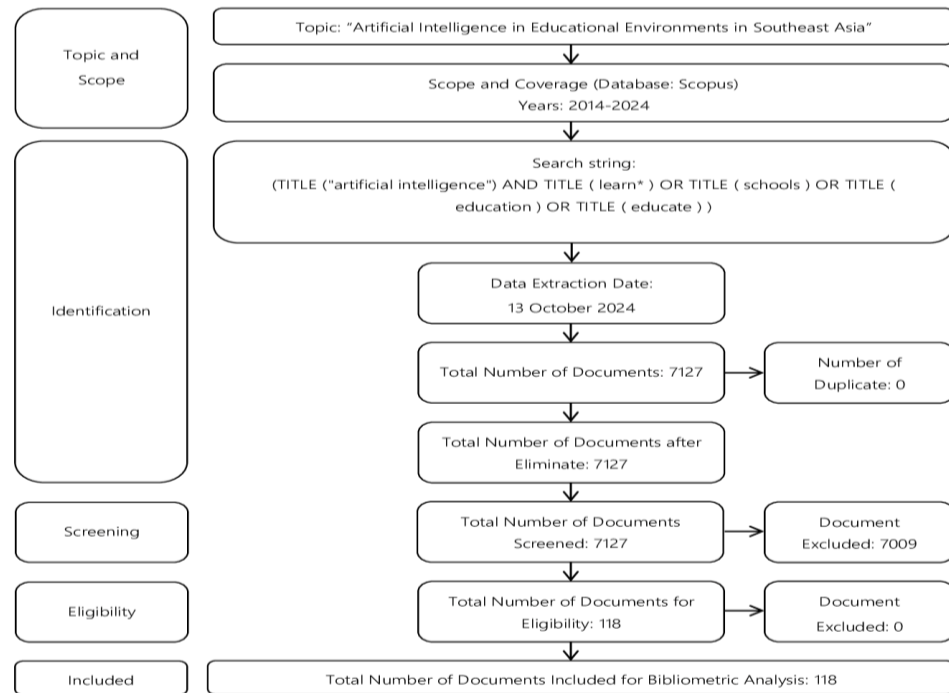


Figure 1. Selection of Documents analyzed using the PRISMA method

Using predefined keywords, we collected 7,127 initial documents related to artificial intelligence (AI) research in education. In the screening stage, we narrowed the scope of the documents by limiting the category to the field of “Social Sciences” and focusing the country location only on the Southeast Asia region. This screening process reduced the number of relevant documents to 118 documents that passed the Eligibility and Included stages. After obtaining the appropriate number of documents, we proceeded with data analysis using R Program software for statistical analysis and VOSviewer to visualize relationships between studies as well as keyword trends. This method allowed us to see the collaboration patterns, most influential authors, and major themes in AI research in education in the region, thus providing deeper insights into the development of research in this field.

RESULTS AND DISCUSSION

Main Information

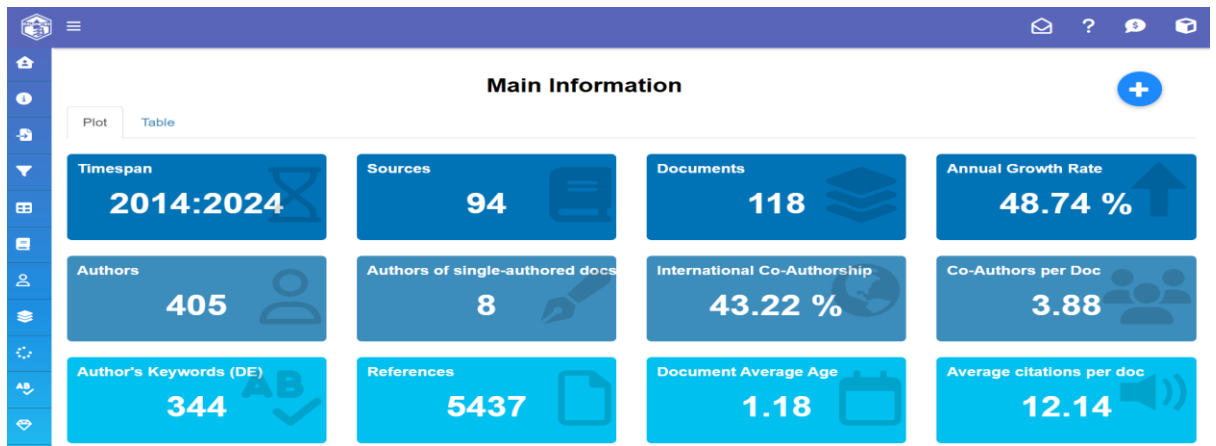


Figure 2. Main Information

Based on the information from the figure, the time span of research on AI in education analyzed is from 2014 to 2024, indicating that this research covers a period of one decade. During this time, the annual growth rate of 48.74% indicates a significant increase in the number of studies each year, indicating that this topic is gaining more attention from researchers. A total of 405 authors were involved in the 118 documents analyzed, with 43.22% of these documents involving international collaboration, highlighting the importance of cross-border cooperation in AI research in education. There were an average of 3.88 authors per document, reflecting the tendency for researchers to work in teams. In addition, these documents refer to 5,437 references, indicating that research in this area is supported by a fairly broad and deep foundation of literature. The resulting research is also quite frequently cited, with an average of 12.14 citations per document, indicating a significant impact in academia.

Publication Trends

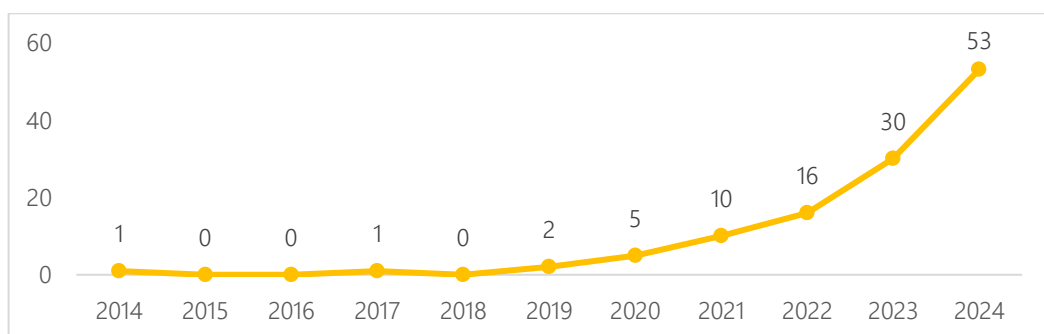


Figure 3. Year-to-Year Publication Trends

Based on the data provided, it can be seen that research on artificial intelligence (AI) in educational settings has fluctuated significantly over the period 2014 to 2024. In 2014, there was only 1(1.18%) published study, but in the following years, such as 2015, 2016, and 2018, there were no studies listed. The absence of research in some of these years may be due to the lack of attention or resources allocated to this field, or because AI technology is

still in the early stages of development in the education sector, so it has not attracted the attention of many researchers. Only in 2017, 1(1.18%) more document appeared, but the increase was still very slow until 2019.

Starting in 2020, the amount of research on AI in educational settings began to experience a significant spike. In 2020, there were 5(5.9%) documents, which doubled to 10(11.8%) documents in 2021, and continued to rise to 16 documents in 2022. This growth continued more sharply in 2023 with 30 documents, peaking in 2024 with 53(62.54%) documents. This drastic increase likely reflects the growing global awareness of AI's potential to improve education systems, as well as the widespread adoption of digital technologies in education, especially after the impact of the COVID-19 pandemic. The year 2024 will be the peak number of studies, showing that the field has become a highly relevant and interesting topic for academics around the world.

The Most Productive Sources

Table 1 Top 5 Most Productive Countries on Research on AI in Education in Southeast Asia

Rank	Country	Articles	%	Citations	%
1 st	Singapore	17	14.4%	129	10.50%
2 nd	Indonesia	13	11.0%	77	6.27%
3 rd	Malaysia	12	10.2%	134	10.91%
4 th	Thailand	10	8.5%	64	5.21%
5 th	Philippines	5	4.2%	2	0.16%

Source: R Program, Data analyzed on October 13, 2024

Based on the data, Singapore ranked first with 17 (14.4%) articles and 129 (10.50%) citations, indicating a significant contribution to AI research in educational settings in Southeast Asia. Indonesia and Malaysia also made sizable contributions, with 13 and 12 articles respectively, followed by almost equal citations of 77(6.27%) for Indonesia and 134(10.91%) for Malaysia. Although Thailand had 10(8.5%) articles, its citation count was lower with 64(5.21%). On the other hand, the Philippines contributed 5(4.2%) articles but only got 2(0.16%) citations, which shows a contribution in the number of publications, although the impact of citations is relatively small. Overall, all these countries contributed to the development of AI research in education, albeit with variations in the number of publications and citation impact.

The Most Productive Affiliations

Table 2 Top 5 Most Productive Affiliations on Research on AI in Education in Southeast

Asia

Rank	Affiliation	City	Country	Articles	%
1 st	Nanyang Technological University	Singapore	Singapore	20	16.95%
2 nd	National University of Singapore	Singapore	Singapore	12	10.17%
3 rd	Universitas Negeri Surabaya	Surabaya	Indonesia	7	5.93%
4 th	Northeastern Mindanao State University	Surigao del Sur	Philippines	6	5.08%
5 th	RMIT University	Melbourne	Australia	6	5.08%

Source: R Program, Data analyzed on October 13, 2024

According to the data, Nanyang Technological University (NTU) leads the contributions with 20 articles, accounting for 16.95% of the total publications in the field of AI in education. Following closely is the National University of Singapore, which produced 12 articles, highlighting Singapore's strong emphasis on research in this domain. Universitas Negeri Surabaya from Indonesia ranks third with 7(5.93%) articles, demonstrating the growing interest in AI research within the Indonesian education sector. Both Northeastern Mindanao State University and RMIT University contribute equally with 6 articles each, representing 5.08% of the total. Overall, these institutions collectively contribute to the advancement of AI research in education, reflecting a diverse and expanding research landscape across Southeast Asia, with varying degrees of output that enrich the academic dialogue in this important field.

The Most Productive Source

Table 3 Top 5 Most Productive Source on Research on AI in Education in Southeast Asia

Rank	Journal	SQ	h-index	TC	NP
1 st	Sustainability (Switzerland)	Q1	4	173	4
2 nd	International Journal of Information and Education Technology	Q3	3	21	3
3 rd	Asia Pacific Journal of Education	Q2	2	4	2
4 th	Education and Information Technologies	Q1	2	173	5
5 th	Foods	Q1	2	62	2

Source: R Program, SQ: Scopus Quartile (Data checked on October 13, 2024), TC: Total of Citation, NP: Number of Publication

Based on the data, the journals contributing to research on AI in education are dominated by journals in the Q1 category, which is the highest ranking in the quality of

scientific journals. Sustainability (Switzerland) and Education and Information Technologies fall into the Q1 category with an h-index of 4 and 2 respectively, showing significant influence through the number of citations, which is 173. Foods also falls into the Q1 category with an h-index of 2 and 62 citations. Other journals such as International Journal of Information and Education Technology (Q3) and Asia Pacific Journal of Education (Q2) also contributed, albeit with lower numbers of citations and publications. Overall, although the contribution of each journal varies, the dominance of Q1 journals shows that the topic of AI in education is attracting interest from high-quality publishers, which strengthens its impact in the academic literature.

The Most Productive Authors

Table 4 Top 5 Most Productive Authors on Research on AI in Education in Southeast Asia

Rank	Author	Affiliation	Country	h-index	TC	NP
1st	Sayed Fayaz Ahmad	Institute of Business Management	Pakistan	3	183	3
2nd	Muhammad Mansoor Alam	Universiti Kuala Lumpur	Malaysia	3	183	3
3rd	Samson Tan	Director of Learning and Professional Development	Singapore	3	54	4
4th	Seng Chee Tan	Nanyang Technological University	Singapore	3	48	4
5th	Anirban Adak	University of Technology Sydney	Australia	2	62	2

Source: R Program (Data checked on October 13, 2024), TC: Total of Citation, NP: Number of Publication

Based on the data, Sayed Fayaz Ahmad from the Institute of Business Management tops the list with an h-index of 3, 183 total citations, and 3 publications, indicating significant contributions in related research. Meanwhile, Singapore dominates with two leading researchers: Samson Tan and Seng Chee Tan, each with an h-index of 3, with a higher number of publications, 4, confirming the country's important role in the development of AI research in education. Malaysian researcher Muhammad Mansoor Alam also shows great influence with an h-index of 3 and 183 citations, similar to Sayed Fayaz Ahmad. Anirban Adak from the University of Technology Sydney, despite having an h-index of 2, still made significant contributions. Overall, researchers from different countries play an important role in advancing AI research in education, with a clear dominance from Singapore.

The Documents with the Highest Citations

Table 5 Top 5 Documents with the Highest Citations on Research on AI in Education in

Southeast Asia

Rank	Citations	Title	Total Citations
1 st	(Paranjape et al., 2019)	Introducing artificial intelligence training in medical education	234
2 nd	(Nguyen et al., 2023)	Ethical principles for artificial intelligence in education	166
3 rd	(Xia et al., 2022)	A self-determination theory (SDT) design approach for inclusive ...	123
4 th	(Okunlaya et al., 2022)	Artificial intelligence (AI) library services innovative conceptual framework...	92
5 th	(Huang et al., 2021)	A Review on Artificial Intelligence in Education	75

Source: R Program (Data checked on October 13, 2024)

On the list of highest citations, the article Paranjape et al. (2019) ranked first with 234 citations. This study focuses on the introduction of artificial intelligence (AI) training in medical education, signaling the importance of AI in shaping the capabilities of future medical professionals. The second place is occupied by Nguyen et al. (2023) with 166 citations, which highlights ethical principles for the application of AI in education, reflecting the relevance of ethical issues in the use of this technology. In third place, Xia et al. (2022) received 123 citations with research utilizing self-determination theory to design inclusive and diverse AI education. Furthermore, Okunlaya et al. (2022) ranked fourth with 92 citations, offering a new conceptual framework for AI library services in the digital transformation of university education. Finally, Huang et al. (2021) received 75 citations with a comprehensive review of AI in education.

These studies cover a wide range of topics, from the application of AI in medical training to digital library services and inclusive education. This variety of perspectives demonstrates the breadth of AI's impact on education in different fields. While each article has a different focus, they all contribute to the development of a deeper understanding of the potential and challenges that arise with the integration of AI in education systems. The diversity of topics raised in this research enriches the academic literature and offers insights into how AI can be adopted and applied in various educational contexts.

Focus Research

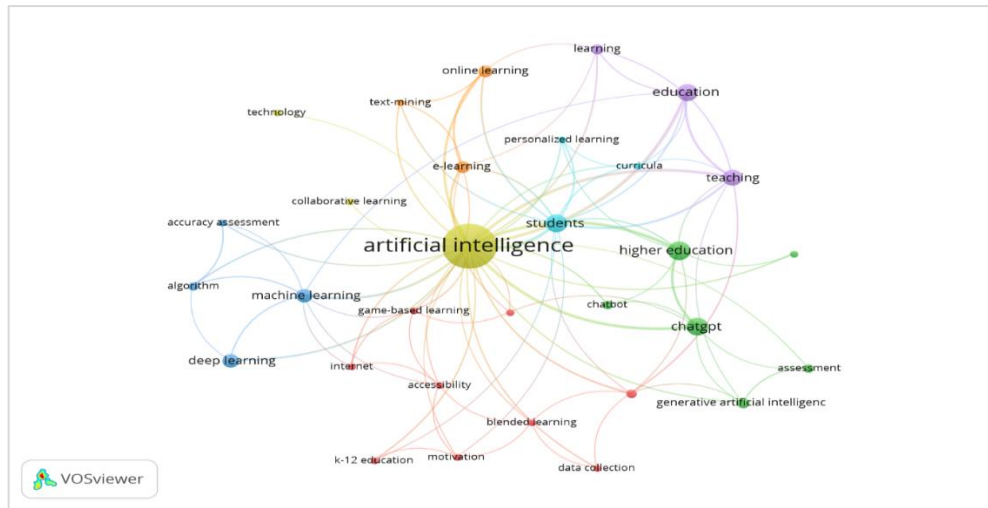


Figure 4 Network Visualization in VOSviewer (Keyword Occurance ≤ 2)

With Keyword Occurance ≤ 2 , researchers get 31 items consisting of 7 clusters. Next, the researcher identifies the name based on the grouping of key data and ends with an interpretation per cluster.

Table 6 Color Based Keywords in VOSviewer

No	Cluster Color	Keywords	Cluster Name
1	Red	Accessibility, Blended Learning, Computer Aided Instruction, Data Collection, Game-based Learning, Internet, K-12 Education, Motivation, Quality Education	Inclusive and Digital Learning
2	Green	Assessments, Chatbot, ChatGPT, Digital Transformation, Generative Artificial Intelligence, Higher Education	Digital Tools in Higher Education
3	Blue	Accuracy Assessment, Algorithm, Deep Learning, Machine Learning	Algorithmic Learning Techniques
4	Yellow	Artificial Intelligence, Collaborative Learning, Technology	Collaborative Educational Technology
5	Purple	Education, Learning, Teaching	Pedagogical Approaches
6	Navy Blue	Curricula, Personalized Learning, Students	Personalized Learning Paths
7	Orange	E-learning, Online Learning, Text-mining	E-learning and Data Analysis

Source: VOSviewer, data analyzed on October 14, 2024

The cluster titled "Inclusive and Digital Learning" covers various aspects of education that aim to improve the accessibility and quality of learning with the help of technology.

Keywords such as Blended Learning, Computer Aided Instruction and Game-based Learning show how teaching methods can utilize digital tools to create a more interactive and immersive learning experience. This cluster also includes the concepts of K-12 Education and Motivation, which emphasize the importance of encouraging early student engagement in an inclusive and supportive educational environment, both through internet accessibility and efficient data collection to improve the quality of education.

The “Digital Tools in Higher Education” cluster focuses on the role of technology in higher education, particularly in terms of digital transformation and the use of generative tools such as ChatGPT and Chatbot to support teaching and learning. These technologies play an important role in providing automated assessment and feedback to students, enabling more personalized and responsive learning. With generative technologies in place, higher education is increasingly able to adopt more efficient and innovative strategies, accelerate digital transformation and improve the quality of teaching and evaluation.

The “Algorithmic Learning Techniques” cluster discusses the technologies that underlie various learning tools, such as Machine Learning, Deep Learning, and Algorithms. These technologies play a role in optimizing the accuracy of assessment in education as well as analyzing student learning patterns. Through the use of sophisticated algorithms, educational institutions can develop learning systems that can adapt to the needs of each student, so that learning can be adjusted in real-time and more efficiently. This technology also provides great opportunities for more in-depth analysis of educational data.

The “Collaborative Educational Technology” cluster addresses how technology can be used to foster collaborative learning among students and faculty. With advancing technologies, such as internet-based collaborative tools and distance learning platforms, students and teachers can interact more efficiently in the learning process. In addition, this cluster also underlines the importance of Collaborative Learning in future education, where technology enables more engagement and collaboration between users, both in physical and virtual classrooms. The cluster titled “Pedagogical Approaches” discusses the basic concepts of education that include approaches to learning, teaching, and education itself. Here, it is emphasized that AI can help strengthen traditional teaching methods while offering innovative new ways to deliver knowledge. The use of technology in education can support teachers in modifying their pedagogical approaches according to evolving student needs and global education trends.

Furthermore, the “Personalized Learning Paths” cluster focuses on how curricula can be tailored to the individual needs of students. Keywords such as Curricula, Personalized Learning and Students indicate that personalization is an important factor in creating a more

relevant and effective learning experience. Technology allows students to take tailored learning paths, according to their pace and preferences, making learning more meaningful and purposeful. Finally, the “E-learning and Data Analysis” cluster addresses the role of online learning and text analysis in educational development. With keywords such as E-learning, Online Learning, and Text-mining, this cluster emphasizes the importance of digital technology in providing wider access to learning, while utilizing data from the learning process to improve the quality and effectiveness of education. Analyzing data from online learning interactions can provide valuable insights to improve teaching methods and better understand student needs.

Keywords Novelty

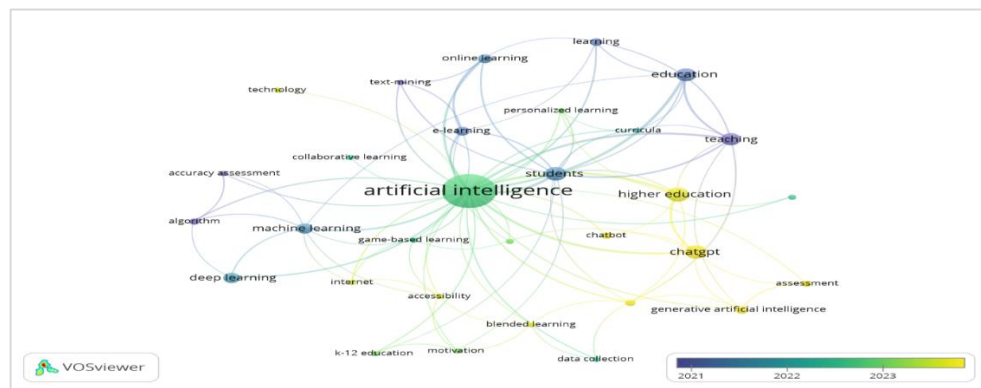


Figure 5 Overlay Visualization in VOSviewer

Yellow keywords indicate new trends in research, and include terms such as Computer Aided Instruction, Chatbot, ChatGPT, Assessment, and Generative Artificial Intelligence. These terms reflect relatively new and innovative technologies that are not yet widely used in educational research contexts, but have great potential for future applications. Computer Aided Instruction can help in enhancing technology-based learning processes, while Chatbot and ChatGPT present new opportunities to create more responsive and personalized interactions between students and the education system. Assessment is also an area that can be further developed using generative technologies, which allow for more accurate and efficient evaluations. As such, the use of these keywords could be a recommendation for future research, particularly in exploring how these technologies can be more widely integrated in the education system to improve the quality of teaching and learning.

CONCLUSION

From the analysis, it can be concluded that research on AI in Education in Southeast Asia in the Scopus database started from 2014 to 2024, with the peak contribution occurring in the last year. Singapore is the most productive country, followed by Nanyang Technological University (NTU) as the leading affiliate in publications in this field. The most prolific source came from the journal *Sustainability* (Switzerland), while Sayed Fayaz Ahmad from Pakistan was noted as the author with the most contributions and highest h-index. Paranjape et al. (2019) is the study with the highest citations. There are seven clusters formed, with keywords such as Computer Aided Instruction, Chatbot, ChatGPT, Assessment, and Generative Artificial Intelligence being recommendations for further research in the field of AI in education in Southeast Asia.

REFERENCES

- Ahmad, S. F., Alam, M. M., Rahmat, M. K., Mubarik, M. S., & Hyder, S. I. (2022). Academic and administrative role of artificial intelligence in education. *Sustainability*, *14*(3), 1101.
- Andrian, D., Wahyuni, A., Ramadhan, S., Novilanti, F. R. E., & Zafrullah. (2020). Pengaruh Pembelajaran Kooperatif Tipe STAD Terhadap Peningkatan Hasil Belajar, Sikap Sosial, dan Motivasi Belajar. *Inomatika*, *2*(1), 65–75. <https://doi.org/10.35438/inomatika.v2i1.163>
- Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, *8*, 75264–75278. <https://doi.org/10.1109/ACCESS.2020.2988510>
- Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: the state of the field. *International Journal of Educational Technology in Higher Education*, *20*(1). <https://doi.org/10.1186/s41239-023-00392-8>
- Fitriani, A. (2023). Biblioshiny: Implementation of Artificial Intelligence in Education (1976-2023). *Journal of Technology Global*, *1*(01), 11–25.
- Gligorea, I., Cioca, M., Oancea, R., Gorski, A.-T., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: a literature review. *Education Sciences*, *13*(12), 1216.
- Górriz, J. M., Ramírez, J., Ortíz, A., Martínez-Murcia, F. J., Segovia, F., Suckling, J., Leming, M., Zhang, Y. D., Álvarez-Sánchez, J. R., Bologna, G., Bonomini, P., Casado, F. E., Charte, D., Charte, F., Contreras, R., Cuesta-Infante, A., Duro, R. J., Fernández-Caballero, A., Fernández-Jover, E., ... Ferrández, J. M. (2020). Artificial intelligence within the interplay between natural and artificial computation: Advances in data science, trends and applications. *Neurocomputing*, *410*, 237–270. <https://doi.org/10.1016/j.neucom.2020.05.078>

- Hamdi, S., Murdiyani, N. M., Fauzan, M., Djidu, H., Chrisdiyanto, E., & Zafrullah, Z. (2024). Developing an assessment instrument for strengthening the Pancasila student profile in web-based middle school mathematics teaching. *Jurnal Elemen*, *10*(3), 479–500.
- Huang, J., Saleh, S., & Liu, Y. (2021). A Review on Artificial Intelligence in Education. *Academic Journal of Interdisciplinary Studies*, *10*(3 SE-Research Articles), 206. <https://doi.org/10.36941/ajis-2021-0077>
- Iriyani, S. A., Hadi, H. S., Marlina, M., Patty, E. N. S., & Irhas, I. (2023). Analisis Bibliometrik dengan VOSViewer: Studi Artificial Intelligence dalam Pendidikan. *Jurnal Simki Pedagogia*, *6*(2), 339–349. <https://doi.org/10.29407/jsp.v6i2.287>
- Izzulhaq, B. D., Gunawan, R. N., Zafrullah, Z., Ayuni, R. T., Ramadhani, A. M., & Fitria, R. L. (2024). Research Trends on Leadership in Indonesian Schools: Bibliometric Analysis (2008-2024). *Elementaria: Journal of Educational Research*, *2*(1), 19–38.
- Karyadi, B. (2023). Pemanfaatan Kecerdasan Buatan Dalam Mendukung Pembelajaran Mandiri. *Educate: Jurnal Teknologi Pendidikan*, *8*(2), 253–258. <https://doi.org/10.32832/educate.v8i02.14843>
- Kilag, O. K. T., Dejino, J. A., Almendras, R. C., Arcillo, M. T., Mansueto, D. P., & Abendan, C. F. K. (2023). Enhancing Student Engagement in Multimedia-Mediated Constructivist Learning: Exploring Students' Perceptions. *EUROPEAN JOURNAL OF INNOVATION IN NONFORMAL EDUCATION*, *3*(6), 51–59.
- Ma, X., Xie, Y., Yang, X., Wang, H., Li, Z., & Lu, J. (2024). Teacher-student interaction modes in smart classroom based on lag sequential analysis. *Education and Information Technologies*, 1–25.
- Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B.-P. T. (2023). Ethical principles for artificial intelligence in education. *Education and Information Technologies*, *28*(4), 4221–4241.
- Okunlaya, R. O., Syed Abdullah, N., & Alias, R. A. (2022). Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. *Library Hi Tech*, *40*(6), 1869–1892.
- Pannu, A. (2015). Artificial intelligence and its application in different areas. *Artificial Intelligence*, *4*(10), 79–84.
- Paranjape, K., Schinkel, M., Panday, R. N., Car, J., & Nanayakkara, P. (2019). Introducing artificial intelligence training in medical education. *JMIR Medical Education*, *5*(2), e16048.
- Pathania, M., Mantri, A., Kaur, D. P., Singh, C. P., & Sharma, B. (2023). A chronological literature review of different augmented reality approaches in education. *Technology*,

Knowledge and Learning, 28(1), 329–346.

- Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, 12(1). <https://doi.org/10.1186/s41039-017-0062-8>
- Ramadhani, A. M., & Retnawati, H. (2024). Computational Thinking and its Application in School: A Bibliometric Analysis (2008-2023). *International Conference on Current Issues in Education (ICCIE 2023)*, 329–338. https://doi.org/10.2991/978-2-38476-245-3_35
- Ramadhani, A. M., Yakob, N. Y. B., Ayuni, R. T., Zafrullah, Z., & Bakti, A. A. (2024). TRENDS IN IMPLEMENTATION OF GAME USE AS LEARNING AT PRIMARY SCHOOLS LEVEL IN SCOPUS DATABASE: A BIBLIOMETRIC ANALYSIS. *Jurnal Penyelidikan Sains Sosial*, 7(23).
- Roll, I., & Wylie, R. (2016). Evolution and Revolution in Artificial Intelligence in Education. *International Journal of Artificial Intelligence in Education*, 26(2), 582–599. <https://doi.org/10.1007/s40593-016-0110-3>
- Sadiku, M. N. O., Musa, S. M., & Chukwu, U. C. (2022). *Artificial intelligence in education*. iUniverse.
- Sudarsana, I. K., Arini, N. W., Mastini, G. N., Sukerni, N. M., & Pusparini, L. D. (2020). *Learning media: The development and its utilization*. Yayasan Ahmar Cendekia Indonesia.
- Sulastiani, Y., Sholih, S., & Rusdiyani, I. (2023). Development of Online-Based Interactive Video Media using Teachmint Application for Natural Science Learning. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 11(3), 890–898.
- Susanto, E. (2023). Analisis Implementasi Kecerdasan Buatan Dalam Pembelajaran. *Sindoro Cendekia Pendidikan*, 7(8), 101–112.
- Tapalova, O., & Zhiyenbayeva, N. (2022). Artificial intelligence in education: AIED for personalised learning pathways. *Electronic Journal of E-Learning*, 20(5), 639–653.
- Ulwiyah, S. (2023). RASCH MODEL ANALYSIS ON MATHEMATICS TEST INSTRUMENTS: BIBLIOSHINY (1983-2023). *Mathematics Research and Education Journal*, 7(2), 1–13. [https://doi.org/10.25299/mrej.2023.vol7\(2\).14550](https://doi.org/10.25299/mrej.2023.vol7(2).14550)
- Verde, A., & Valero, J. M. (2021). Teaching and learning modalities in higher education during the pandemic: responses to coronavirus disease 2019 From Spain. *Frontiers in Psychology*, 12, 648592.
- Wahyuni, A., Kusumah, Y. S., Martadiputra, B. A. P., & Zafrullah, Z. (2024). Tren penelitian kemampuan pemecahan masalah pada pendidikan matematika: Analisis bibliometrik.

JPMI (Jurnal Pembelajaran Matematika Inovatif), 7(2), 337–356.
<https://doi.org/10.22460/jpmi.v7i2.22329>

- Xia, Q., Chiu, T. K. F., Lee, M., Sanusi, I. T., Dai, Y., & Chai, C. S. (2022). A self-determination theory (SDT) design approach for inclusive and diverse artificial intelligence (AI) education. *Computers & Education*, 189, 104582.
- Zafrullah, Z., Ayuni, R. T., Gunawan, R. N., Mutiara, E., Laksita, G. D., & Adawiyah, N. (2024). Tren Penggunaan E-Learning Pada Penelitian Pendidikan Anak Usia Dini: Analisis Bibliometrik (2003-2023). *AWLADY: Jurnal Pendidikan Anak*, 10(2), 141–154.
- Zafrullah, Z., Fitriani, A., Ramadhani, A. M., & Hidayah, S. M. N. (2023). Transformasi adobe flash dalam dunia pendidikan: Analisis bibliometrik (2006-2023). *Indo-MathEdu Intellectuals Journal*, 4(3), 1652–1666. <https://doi.org/10.54373/imeij.v4i3.387>
- Zafrullah, Z., Hakim, M. L., & Angga, M. (2023). ChatGPT open AI: Analysis of mathematics education students learning interest. *Journal of Technology Global*, 1(01), 1–10. <https://penaeducentre.com/index.php/JTeG/article/view/35/33>
- Zafrullah, Z., Hardi, V. A., Nabilah, N., & Fitriani, A. (2024). Transforming the Utilization of ChatGPT in Education: A Bibliometric Analysis. *Innovative: Journal Of Social Science Research*, 4(1), 5610–5623. <https://doi.org/10.31004/innovative.v4i1.5578>
- Zafrullah, Z., Ibrahim, Z. S., Ariawan, R., Ulwiyah, S., & Ayuni, R. T. (2024). Research on Madrasas in International Publications: Bibliometric Analysis with Vosviewer. *COMPETITIVE: Journal of Education*, 3(2), 116–127. <https://doi.org/10.58355/competitive.v3i2.93>
- Zafrullah, Z., Meisya, A., & Ayuni, R. T. (2024). Artificial Intelligence as a Learning Media in English Education: Bibliometric using Biblioshiny Analysis (2009-2023). *ELTR Journal*, 8(1), 71–81.
- Zafrullah, Z., & Ramadhani, A. M. (2024). The Use of Mobile Learning in Schools as A Learning Media: Bibliometric Analysis. *Indonesian Journal of Educational Research and Technology*, 4(2), 187–202. <https://doi.org/10.17509/ijert.v4i2.65586>
- Zafrullah, Z., Ramadhani, A. M., Awliya, D., & Ayuni, R. T. (2024). Implementasi Project-based Learning di Sekolah: Analisis Bibliometrik (1998-2023): Indonesia. *Ciencias: Jurnal Penelitian Dan Pengembangan Pendidikan*, 7(2), 11–23.
- Zafrullah, Z., Sultan, J., Ayuni, R. T., Sembiring, Y. K., & Fitriani, A. (2024). TREN PENELITIAN PENGGUNAAN GEOGEBRA DI SEKOLAH DASAR PADA DATABASE SCOPUS: ANALISIS BIBLIOMETRIK. *Jurnal Genta Mulia*, 15(2), 210–219.
- Zafrullah, Z., Suyanto, S., Wahyuni, A., Ayuni, R. T., & Novilanti, F. R. E. (2023). Development of android-based learning to improve computational thinking skills in junior high

school. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(2), 1309–1320.

Zafrullah, Z., & Zetriuslita, Z. (2021). Minat belajar siswa kelas VII terhadap media pembelajaran matematika berbantuan Adobe Flash CS6. *Math Didactic: Jurnal Pendidikan Matematika*, 4(2), 114–123.

Zafrullah, Z., Zetriuslita, Z., Rezeki, S., & Suripah, S. (2024). Development Of Interactive Multimedia Learning Mathematics Learning Media Using Adobe Flash Cs6. *Mathematics Research and Education Journal*, 8(1), 17–28.

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., Liu, J. B., Yuan, J., & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*, 2021. <https://doi.org/10.1155/2021/8812542>